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(56) Documents cited
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EP 0058576 A1 US 5048139 A US 4653294 A
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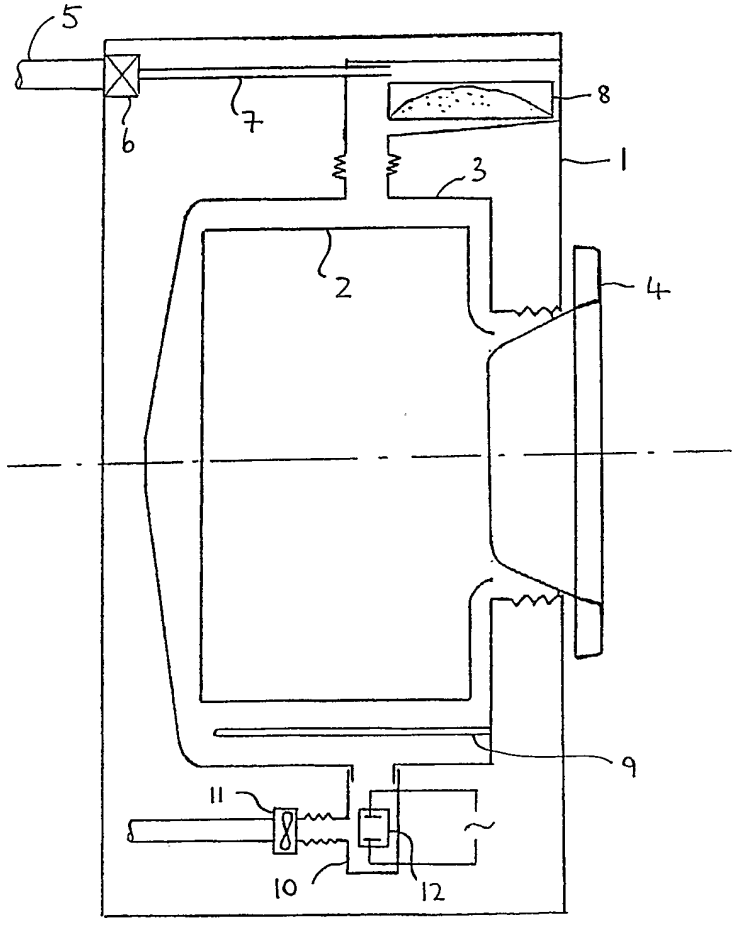
(54) Rinsing in washing machines

(57) In a washing machine which performs a wash stage followed by a plurality of rinse stages, individual rinse stages may be omitted and/or curtailed by reference to the amount of detergent in the tub liquid as measured e.g. by a conductivity sensor (12) in the drain trap (10) and without the necessity for a further sensor monitoring the tap water. Rinsing may be curtailed if either a) the rate of change of conductivity remains below a certain value or b) the conductivity value after any rinse stage shows a percentage drop with respect to the value at the end of the washing stage greater than a predetermined amount. Instead of a conductivity sensor an optical sensor or a foam height sensor may be used.



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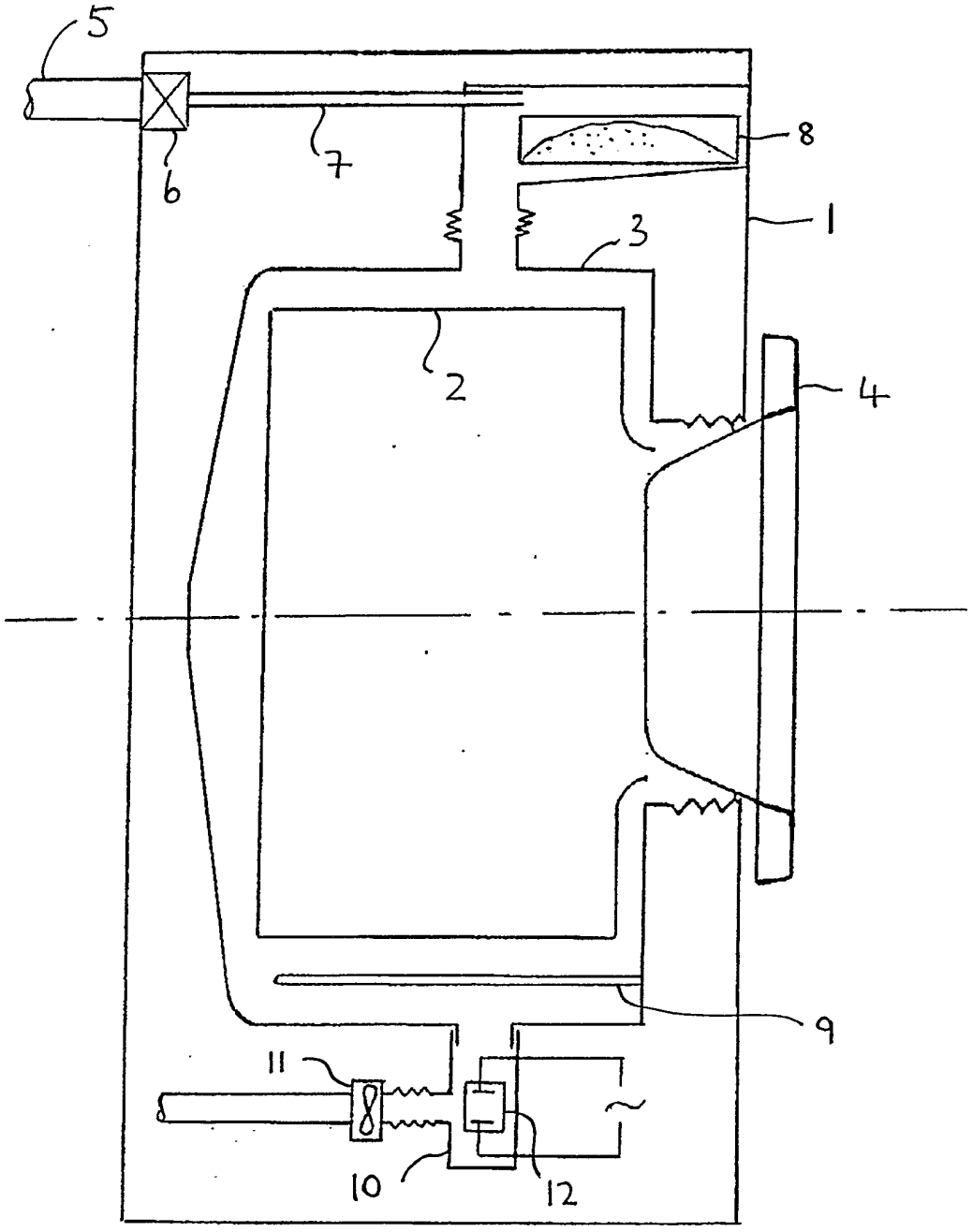
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WASHING MACHINES

This invention relates to washing machines, and especially to the rinse stage of the washing cycle.

During the rinse stages, dirt washed from the load together with detergent is removed. Usually, there is more than one rinse stage after the wash stage. The tub surrounding the clothes-containing drum is filled to a predetermined level with water and detergent is added to the water either by running it through a compartment containing detergent or by including it directly in the drum. At the end of the wash stage, the tub is drained, so that water-containing dirt and detergent are expelled, leaving only the residue still held by the wet load. At each rinse, the drum is filled to roughly the same predetermined level as before with fresh water, and at the end of the rinse water is drained away. Thus, at each rinse, some of the dirt and detergent in the clothes goes into the water and is removed at the end of the rinse.

In current production washing machines, the rinse stages are typically programmed to accommodate worst case conditions i.e. a large absorbent wash load and a maximum

dose of detergent, and there may be four separate rinse stages. This means that, in many cases, e.g. small or less absorbent loads or loads where less detergent has been used, too much rinsing will take place, with the result that water has been wasted, in addition to electricity, while the full wash/rinse cycle has also taken longer than necessary.

Various proposals have been made for controlling the rinse in dependence on the amount of detergent remaining in the water in the drum, this being sensed by optical sensors, conductivity sensors or foam height sensors.

For example, one conductivity sensor proposal relies on the user entering information relating to the type of wash load, detergent type etc.

In another conductivity sensor proposal, the system reads in a value for the conductivity of the incoming tap water at the start of the whole wash/rinse sequence, and uses this reading to determine what conductivity reading is to be aimed for at the end of the rinse sequence.

However, separate means must be provided to sense the conductivity of the incoming tap water in addition to the conductivity sensor provided in the drum, for example, a

conductivity sensor upstream of the detergent compartment.

The invention provides a washing machine comprising means for sensing the amount of detergent in the tub liquid, and means for controlling whence operations by reference to the amount of detergent in the tub liquid.

The invention also provides a washing machine comprising means for sensing the conductivity of the tub liquid, and means for controlling whence operations by reference to the conductivity of the tub liquid.

The arrangement provides for automatic operation while avoiding the need for separate means for sensing parameters of the incoming tap water, since the rinse operations are controlled only by reference to the amount of detergent in the tub liquid e.g. as measured by its conductivity.

A washing machine constructed in accordance with the invention will now be described by way of example with reference to the accompanying drawing, which is a vertical section taken through the centre line of the tub in schematic form.

The washing machine has a cabinet 1 with a

front-loading drum 2 rotatable about a horizontal axis in a tub 3, a door 4 closing the access open to the tub. Fresh tap water enters from a water inlet 5 under the control of a solenoid valve 6, an outlet 7 of which supplies the tub via a detergent dispenser 8. A motor (not shown) is provided for rotating the drum and any necessary heating of the water is carried out by means of heater 9. The drum drains into a trap 10 from which liquid is pumped by means of a pump 11 to a suitable waste outlet.

As is conventional, the washing machine is programmed to be able to perform a wash stage followed by a number of rinse stages. During the wash stage, the tub is filled with water to a predetermined level controlled by sensors (not shown), detergent being washed in from the detergent compartment or distributed from a detergent dispenser loaded into the tub. The load may be heated and/or agitated.

The machine is then drained, and the washing machine is re-filled to the same level controlled by the same level sensors (the volume of water added being e.g. 20 litres to 25 litres). The detergent retained in the load is accordingly diluted, and agitation again takes place. The tub is drained again. This sequence is repeated a number of times, with the exception that conditioner may be added

during the last rinse.

In accordance with the invention, the washing machine includes means for sensing the amount of detergent in the wash water in the form of a conductivity sensor 12, and the rinse operations are controlled with reference to the amount of detergent in the water.

The sensor comprise a pair of electrodes e.g. of chrome-plated brass between which an a.c. signal of e.g. a few millivolts is passed. The liquid between the electrodes acts as an impedance, the value of which depends on the amount of detergent in the water (the detergent being responsible for increasing the ion concentration of the liquid, a small amount of detergent making a large increase in the ion concentration and hence conductivity), the type of detergent, together with the amount of dirt in the water and the hardness of the water. A d.c. signal would result in a false reading not representative of the conductivity since ionisation would be caused at the electrodes by electrolytic action. As an alternative to positioning the electrodes in the drain trap 10, they may be mounted on the inside of the drum below water level.

The sensor produces an output which varies with the

amount of detergent remaining in the wash liquid, the more detergent present, the higher the value of the output.

Means is provided so that repeated samples e.g. 5000 of conductivity are taken by a control system, towards the end of the wash cycle, and the values are averaged to obtain a representative value for the conductivity which in turn gives a measure of the amount of detergent present in the liquid.

The rinse stages may be curtailed in two ways.

First, in any rinse stage, the conductivity is repeatedly sampled during filling, successive groups of five readings being averaged to determine successive conductivity values, from which the rate of change of conductivity is measured. If this stays below a predetermined value for a predetermined length of time, this indicates that the load now contains little detergent (for otherwise the conductivity would increase as the detergent in the load distributed itself through the water flowing into the tub), and that rinse is terminated i.e. the tub is drained and the second rinse is commenced. Indeed, if the conductivity stays below the predetermined value for the predetermined length of time during filling for the rinse stage, the

filling operation is stopped. This is possible since the sampling commences after the drum has filled to a low level.

The second saving of rinse stages results from accessing whether the final conductivity value of the first rinse represents a percentage drop of more than a predetermined amount from the conductivity at the end of the wash sequence e.g. if the conductivity towards the end of the first rinse stage is 80% of the conductivity at the end of the wash stage, then the percentage drop in conductivity will be 20%. This would correspond to a very considerable drop in the amount of detergent. In the case of an absorbent load e.g. towels, a substantial amount of detergent will be returned to the load after the tub has drained and a substantial amount of detergent will thus be present in the water which enters for the second rinse. In the case of a non-absorbent load e.g. synthetic fibres, little detergent will be retained in the load after draining at the end of the wash sequence, and there will be a much bigger percentage drop in the conductivity of the tub liquid.

In the latter case, but not in the former, the washing machine proceeds immediately to its final rinse stage in which conditioner is added. In the former case, the second

rinse is commenced, and is terminated forthwith again if the rate of rise of conductivity is less than a predetermined value.

Again, if the percentage drop of conductivity from the end of the wash stage to the end of the second rinse stage is greater than a second predetermined value, a third rinse is omitted and the machine proceeds directly to the fourth rinse stage including conditioner. Otherwise, the third rinse stage follows and may be terminated early as described above. Equally, the fourth and final rinse stage may be terminated early.

If desired, the amount of detergent in the tub liquid may be sensed by means other than conductivity sensors e.g. optical sensors or foam height sensors.

Among the advantages of the washing machine described is that whole rinse stages will be omitted in appropriate cases and/or rinse stages will be curtailed, possibly even during filling for that rinse stage, thus reducing the time taken to perform the full wash/rinse cycle, the amount of electricity used and the amount of water consumed.

CLAIMS

1. A washing machine comprising means for sensing the amount of detergent in the tub liquid, and means for controlling rinse operations by reference to the amount of detergent in the tub liquid.

2. A washing machine comprising means for sensing the conductivity of the tub liquid, and means for controlling rinse operations by reference to the conductivity of the tub liquid.

3. A washing machine as claimed in claim 2, in which a rinse stage is terminated in use if the rate of change of the conductivity of the tub liquid during that rinse stage is below a predetermined value for a predetermined length of time.

4. A washing machine as claimed in claim 2 or claim 3, in which the washing machine is arranged to perform a wash stage followed by a plurality of rinse stages in use, but if the percentage fall in the conductivity of the detergent in the tub liquid from the wash stage to a rinse stage exceeds a predetermined value, one or more subsequent

rinse stages are omitted.

5. A washing machine as claimed in any one of claims 2 to 4, in which the sensing means comprises a conductivity sensor arranged in a trap leading from the tub.

6. A washing machine substantially as herein described with reference to the accompanying drawings.

Amendments to the claims
have been filed as follows

1. A washing machine arranged to perform a wash stage followed by a plurality of rinse stages, comprising means for sensing the conductivity of the tub liquid, and means for controlling rinse operations by reference to the conductivity of the tub liquid during a rinse stage relative to the conductivity of the tub liquid at the end portion of the wash stage.

2. A washing machine as claimed in claim 1, in which the rinse control means is also arranged to control rinse operations by reference to the rate of change of the conductivity of the tub liquid during a rinse stage.

3. A washing machine as claimed in claim 1 or claim 2, in which the rinse control means is arranged to omit a rinse stage.

4. A washing machine as claimed in any one of claims 1 to 3, in which the rinse control means is arranged to curtail a rinse stage.

5. A washing machine as claimed in claim 1, in which the rinse control means is arranged to terminate a rinse stage if the rate of change of conductivity of the tub liquid is below a predetermined value for a predetermined

length of time.

6. A washing machine as claimed in claim 1, in which the rinse control means is arranged to omit a rinse stage if the percentage fall in the conductivity of the tub liquid from the wash stage to a rinse stage exceeds a predetermined value.

7. A washing machine as claimed in any one of claims 1 to 6, in which the sensing means comprises a conductivity sensor arranged in a trap leading from the tub.

8. A washing machine substantially as herein described with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

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Relevant Technical fields

(i) UK Cl (Edition K) D1A (ACA, ACC)

(ii) Int CL (Edition 5) D06F 33/00, 33/02, 37/00, 39/00

Search Examiner
ALEX LITTLEJOHN

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search
3 JULY 1992

Documents considered relevant following a search in respect of claims 1-6

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 927846 (ELLIS) - see whole document eg page 4 lines 100-127	1-5
X	GB 574273 (FORRESTER) - see whole document especially pages 34 and 35	1-5
X	EP 0383218 A1 (LANG) - see whole document	1-5
X	EP 0058576 A1 (EATON) - see whole document eg page 10 lines 5-13	1-5
X	US 5048139 (MATSUMI) - see whole document especially Column 11 lines 16-38	1-5
X	US 4653294 (AKINAGA) - see whole document eg Column 3 lines 23-47	1-5
X	US 4372134 (MATSUO) - see whole document eg Column 6 lines 14-30	1-5
X	US 4237565 (TORITA) - see whole document eg Columns 3 and 4	1-5

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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ABSTRACT:

CHG DATE=19990617 STATUS=O> In a washing machine which performs a wash stage followed by a plurality of rinse stages, individual rinse stages may be omitted and/or curtailed by reference to the amount of detergent in the tub liquid as measured e.g. by a conductivity sensor (12) in the drain trap (10) and without the necessity for a further sensor monitoring the tap water. Rinsing may be curtailed if either a) the rate of change of conductivity remains below a certain value or b) the conductivity value after any rinse stage shows a percentage drop with respect to the value at the end of the washing stage greater than a predetermined amount. Instead of a conductivity sensor an optical sensor or a foam height sensor may be used. □